Neck River

Watershed Summary

Watershed Description and Maps

The Neck River watershed covers an area of approximately 4,343 acres in the southern coastal area of Connecticut (Figure 1). There are several towns located at least partially in the watershed, including the municipalities Guilford and Madison, CT.

The Neck River watershed includes one segment impaired for recreation due to elevated bacteria levels (CT5107-00_01). This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. An excerpt of the Integrated Water Quality Report is included in Table 1 (CTDEEP, 2010).

The Neck River begins in a large forested area in central Madison northeast of the Route 80 and Route 79 intersection, and ends just downstream of the US Route 1 crossing at the head of tide in southern Madison. The impaired segment is 9.49 miles long and is located entirely within the Town of Madison (Figure 2).

The impaired segment of the Neck River has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of the Neck River, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:
Neck River (CT5107-00_01)

Municipality: Madison

Impaired Segment Length (miles):
9.49

Water Quality Classification:
Class A

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Neck River, 5107

Regional Basin: South Central Eastern Complex

Major Basin: South Central Coast

Watershed Area (acres): 4,343

MS4 Applicable: Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

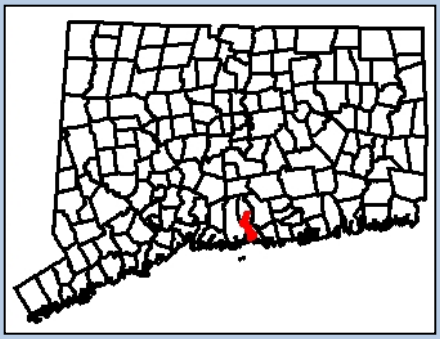


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

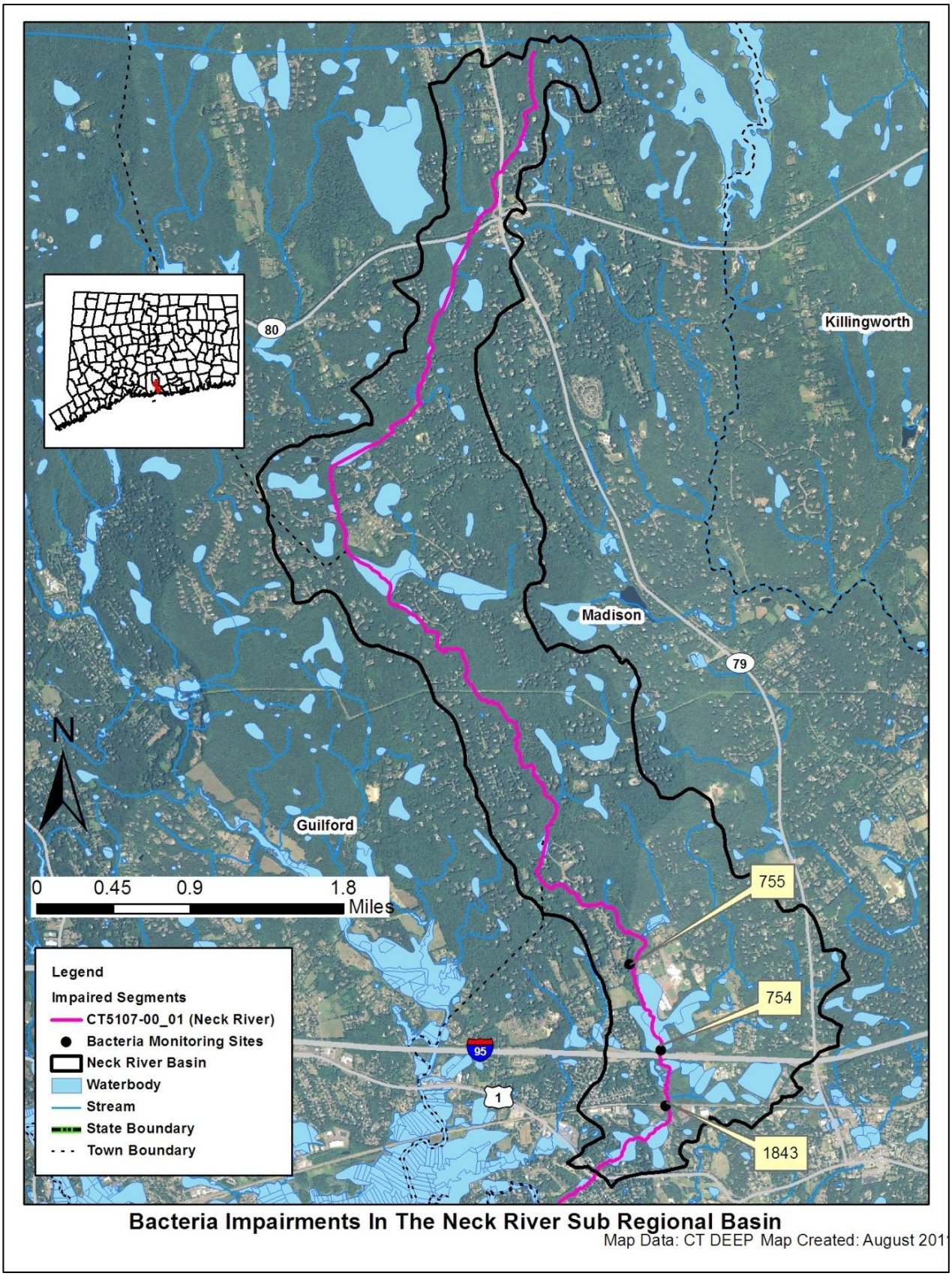
Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT5107-00_01	Neck River-01	From head of tide (marsh exit, parallel to Neck Road, DS of Route 1 crossing), US to headwaters (just north of Neck Road off Route 80 and Route 79 rotary intersection, and south of aqueduct), Madison.	9.49	U	NOT	FULL

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

Figure 2: GIS map featuring general information of the Neck River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Neck River watershed consists of 30% urban area, 58% forest, 2% agriculture, and 10% water. The majority of the watershed surrounding the impaired segment is a mix of urban and forested land uses with some agricultural land uses. There is dense residential and commercial development near the downstream end of the impaired segment to the south of Interstate 95 in southern Madison. There are also several agricultural operations adjacent to the Neck River, particularly near the monitoring stations (Figure 4).

Figure 3: Land use within the Neck River watershed

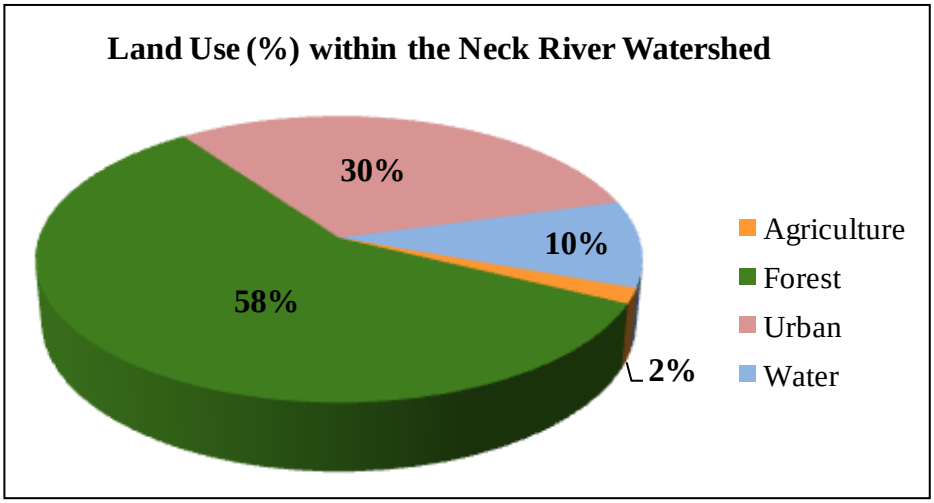
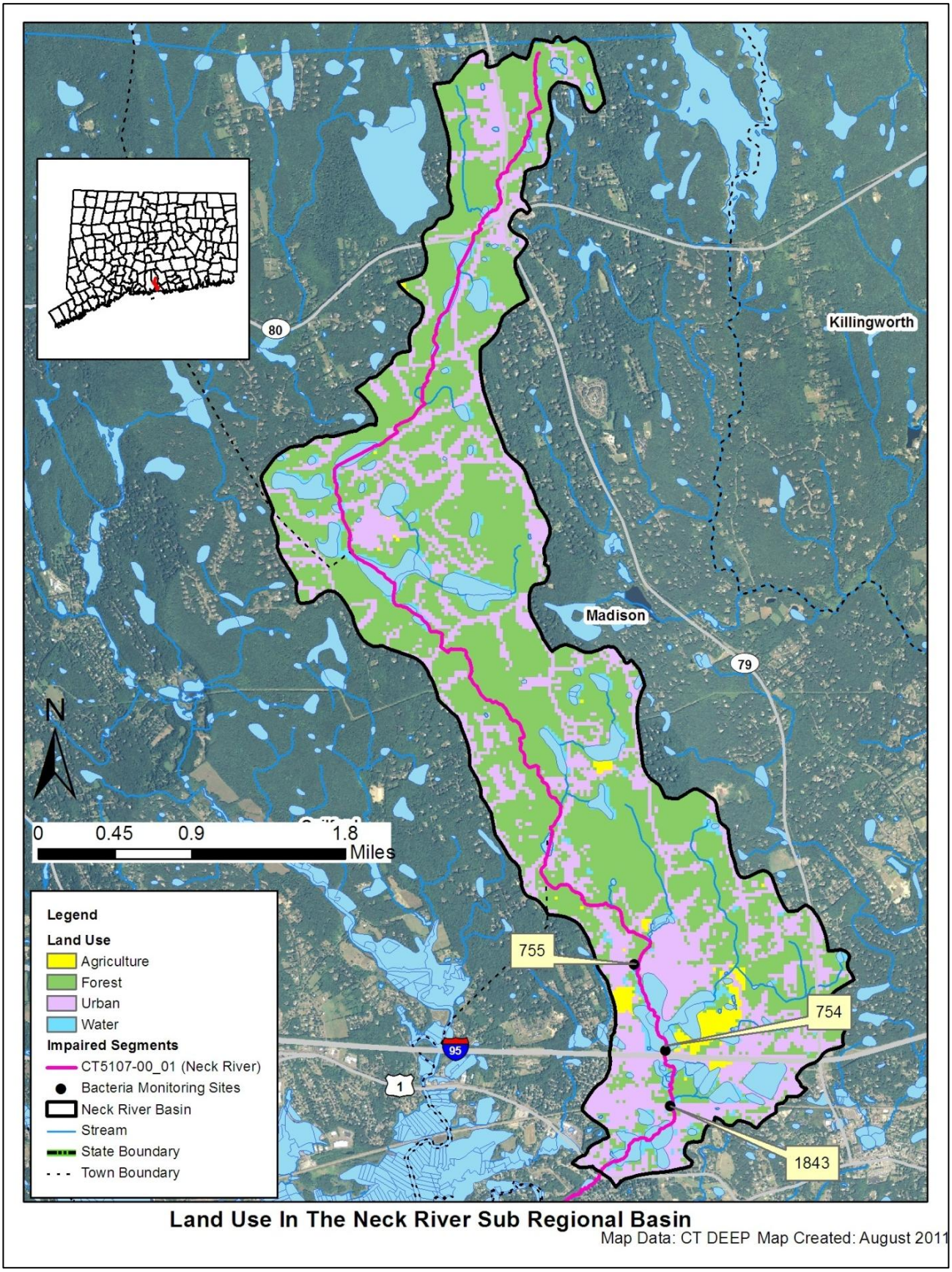


Figure 4: GIS map featuring land use for the Neck River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired segment in the Neck River watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT5107-00_01	Neck River	1843	Fort Path Road (USGS location)	Madison	41.283900	-72.619400
CT5107-00_01	Neck River	754	Route 95	Madison	41.288631	-72.619914
CT5107-00_01	Neck River	755	Green Hill Rd	Madison	41.295917	-72.623456

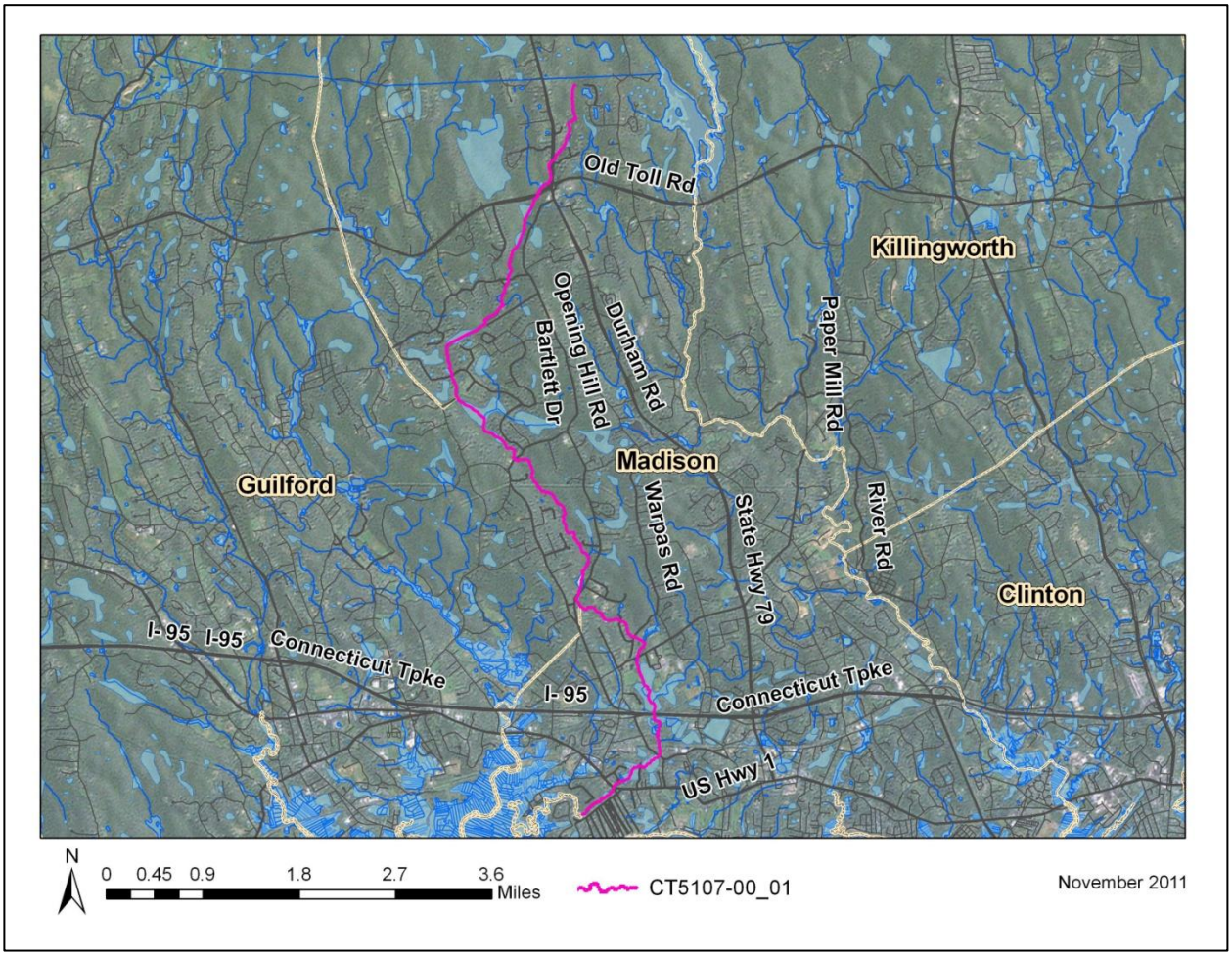
The Neck River (CT5107-00_01) is a Class A freshwater river (Figure 5). Its applicable designated uses are a potential drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from three sampling locations (Stations 1843, 754, and 755) in 2002, 2003, and 2006-2009 (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results in 2002, 2003, and 2006-2009, are presented in Table 8. The annual geometric mean was calculated and exceeded the WQS for *E. coli* in 2006, 2007, and 2008 at Station 1843 and in 2002 at Station 754. Single sample values also exceeded the WQS for *E. coli* in 2006, 2007, and 2008 at Station 1843 and in 2002 at Station 755. The geometric mean could not be calculated for Station 755 as there were insufficient data for analysis.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for wet-weather and dry-weather sampling days (Table 8). Geometric means could not be calculated for Station 754 or 755 during wet-weather due to insufficient data. For Station 1843, the geometric mean during wet-weather exceeded the WQS for *E. coli*. The geometric mean during wet-weather was four times greater than dry-weather at Station 1843.

Due to the elevated bacteria measurements presented in Table 8, this segment of the Neck River does not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the impaired segment of the Neck River



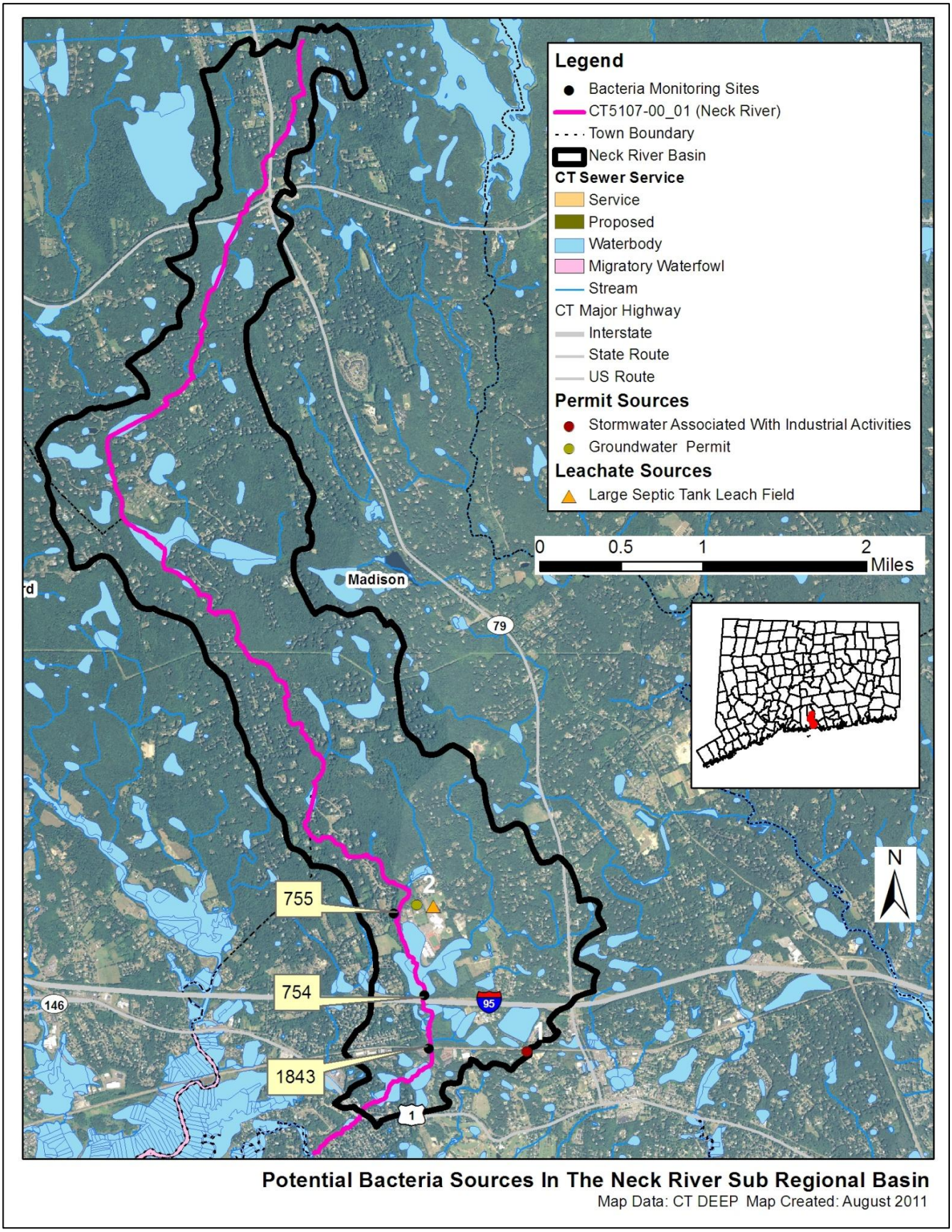
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Neck River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Neck River CT5107-00_01	**x**	**x**		**x**	**x**	**x**	**x**	**x**

Figure 6: Potential sources in the Neck River watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type (Table 6).

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	1
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	1

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Neck River watershed. Bacteria data from the industrial permitted facility is not available. Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Neck River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Madison	Town Of Madison	GSI001298	Stormwater Associated With Industrial Activities	Madison Public Works Garage	1
Madison	Town of Madison	GSM000051	Part B Municipal Stormwater MS4	Madison, Town of	N/A
Madison	Town Of Madison	UI0000376	Groundwater Permit	Daniel Hand High School	2

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut

that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

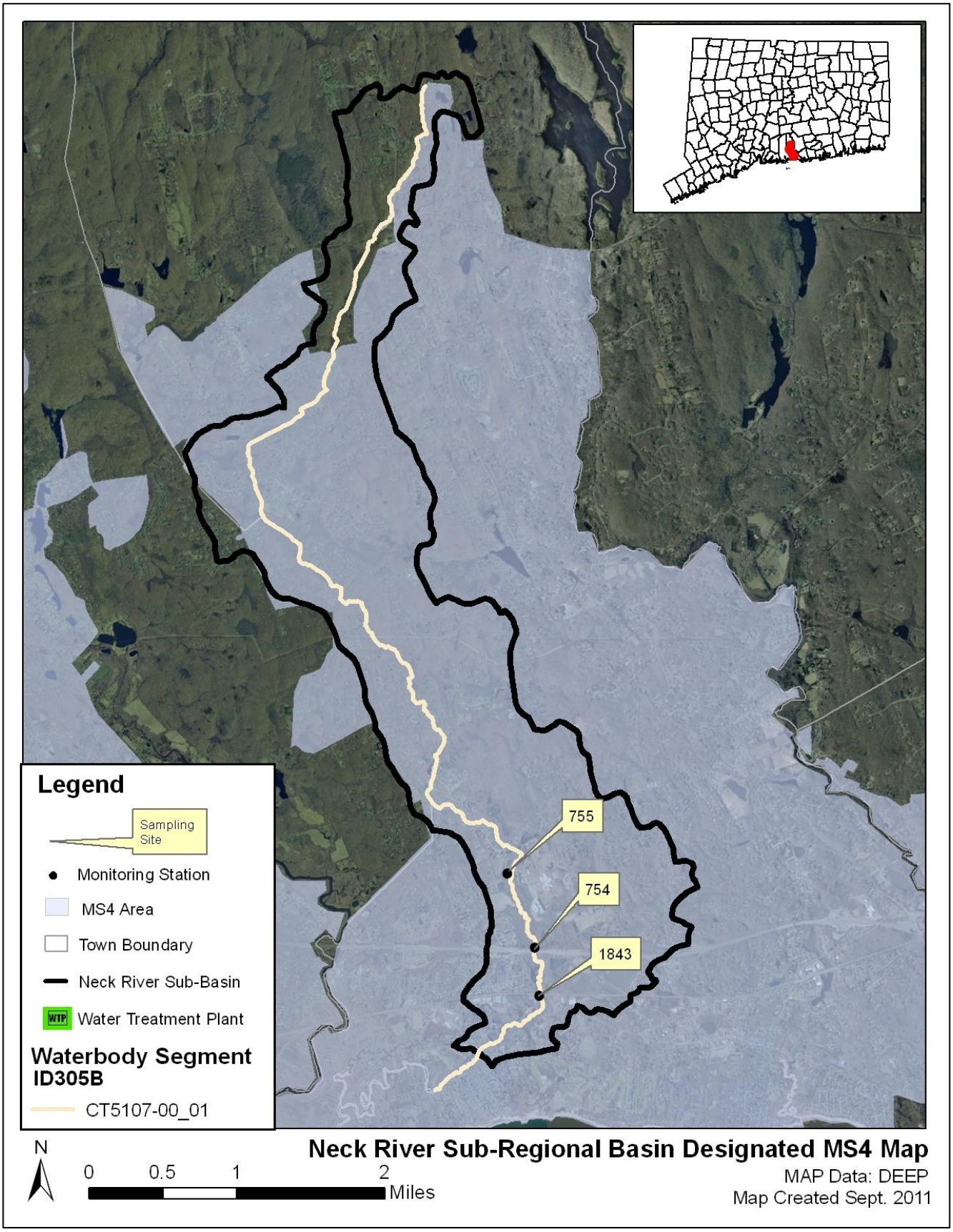
The impaired segment of the Neck River watershed is located within the Town of Madison. Madison has designated urban areas, as defined by the U.S. Census Bureau, and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

One MS4 outfall has been sampled for *E. coli* bacteria in the watershed from 2004-2009 (Table 6). Of the six samples taken, four (67%) exceeded the single sample water quality standard of 410 colonies/100mL.

Table 6: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Neck River watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Madison	168; behind #64 neck road	Residential	Neck River	11/12/04	700
Madison	168; behind #64 neck road	Residential	Neck River	12/29/05	228
Madison	168; behind #64 neck road	Residential	Neck River	10/17/06	344
Madison	168; behind #64 neck road	Residential	Neck River	11/06/07	980
Madison	168; behind #64 neck road	Residential	Neck River	09/09/08	1,986
Madison	168; behind #64 neck road	Residential	Neck River	09/11/09	2,420
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Figure 7: MS4 areas of the Neck River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Neck River watershed are described below.

Insufficient Septic Systems

As shown in Figure 6, residents of the Neck River watershed rely on onsite wastewater treatment systems, such as septic systems. There is a large septic tank leach field located near the impaired segment around Daniel Hand High School off Green Hill Road in Madison (Figure 6). Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Madison has its own health department (http://www.madisonct.org/health/) that handles failing septic systems in the town.

Stormwater Runoff from Developed Areas

While the majority of the Neck River watershed is forested, there are several developed areas in proximity to the impaired segment. Approximately 30% of the watershed is considered urban, and much of that area is concentrated around the impaired segment in the southern portion of Madison near US Route 1 and Interstate 95 (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

A large portion (87%) of the Neck River watershed is characterized by 0-6% impervious cover, 2% is characterized by 7-11% impervious cover, and 11% is characterized by 12-15% impervious cover (Figure 8). The majority of the impaired segment is surrounded by 0-6% impervious cover; however, the impaired segment does flow through significant portions of impervious cover, particularly in its downstream stretches. As such, stormwater runoff from developed areas is a potential source of bacterial contamination.

Figure 8: Range of impervious cover (%) in the Neck River watershed

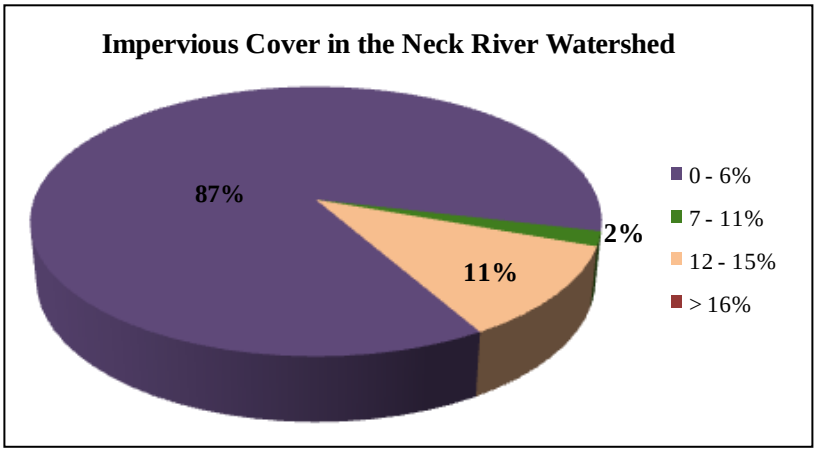
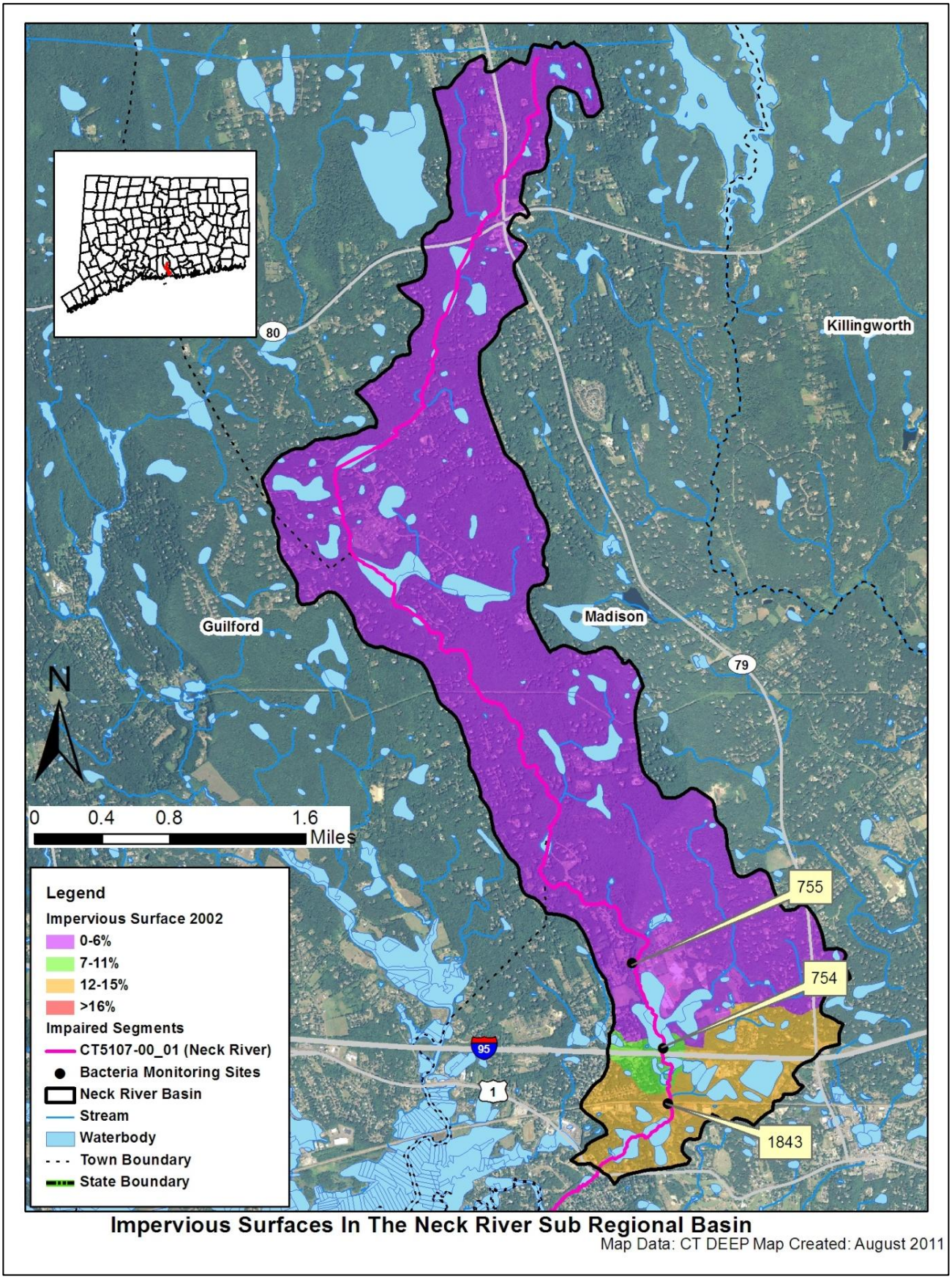


Figure 9: Impervious cover (%) for the Neck River sub-regional watershed



Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Neck River watershed represent another potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural cropfields, golf courses, and ponds. There are several recreational fields in close proximity to the Neck River, including the Daniel Hand High School along Green Hill Road in Madison. The Neck River watershed is comprised of 10% surface water. The small lakes and ponds in the watershed and along the Neck River can provide areas for geese and other waterfowl to congregate. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and ponds and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

Also, urban development surrounds large portions of the impaired segment of the Neck River (Figure 4). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in the Neck River.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up only 2% of the Neck River watershed. However, there are several agricultural areas near the impaired segment, particularly at the Mungertown Road and Green Hill Road intersection in Madison. Agricultural areas near the impaired segment and its tributaries are potentially carrying pollutants, including bacteria, into the Neck River.

Additional Sources

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Neck River. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

Riparian Buffer Zones

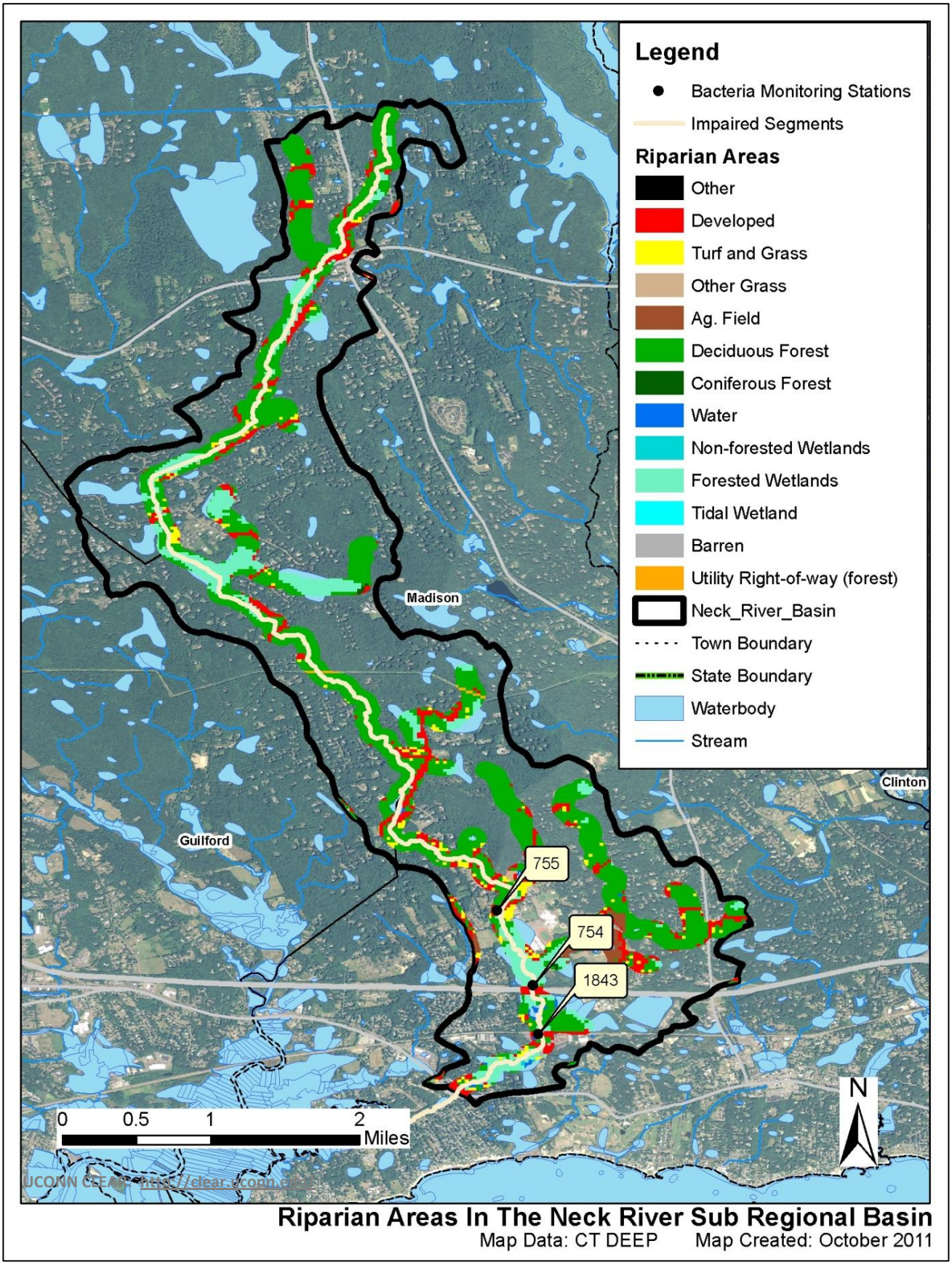
The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms.

Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of the Neck River is characterized by forested land use. However, there are developed, turf grass, and agricultural land uses within the riparian zone of the Neck River (Figure 10). As previously mentioned, developed and agricultural areas are potential sources of bacterial contamination.

Figure 10: Riparian buffer zone information for the Neck River watershed



CURRENT MANAGEMENT ACTIVITIES

The Town of Madison has developed and implemented some programs to protect water quality from bacterial contamination. As indicated previously, the Town of Madison is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Table 7.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Madison, CT (Permit # GSM000051)

Minimum Measure	Madison 2010 Annual Report Update
Public Outreach and Education	1) Distributed booklet on septic systems and stormwater with every Certificate of Occupancy issued.
Public Involvement and Participation	No updates
Illicit Discharge Detection and Elimination	1) Madison's Planning and Zoning Commission has passed interim stormwater regulations to address IDDE issues.
	2) Mapping with GIS all stormwater outfalls. As of 2010, all of the areas South of I-95 and all significant residential areas have been mapped.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater management	No updates.
Pollution Prevention and Good Housekeeping	1) Sent a Stormwater Fact Sheet to all contractors, lawn maintenance, and landscaping companies working within Madison annually.
	2) Clean all catch basins at least once every year.
	3) Sweeps all streets annually, and sweeps the downtown area of Madison every two weeks from spring to fall.

RECOMMENDED NEXT STEPS

As show above, the Town of Madison has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the impaired segment of the Neck River and have been prioritized below.

1) Develop a system to monitor septic systems.

All residents in the watershed rely on septic systems (Figure 6). Madison is currently mapping all stormwater outfalls using GIS. Madison should also establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

2) Identify areas along the developed portions of the impaired segment of the Neck River to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the Town Madison within the Neck River watershed is an MS4 community regulated by the MS4 program. Since 30% of the watershed is considered urban and developed areas are near the impaired segment, stormwater runoff is likely contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment, the towns should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Neck River. To treat stormwater runoff, the town should also identify areas along the more developed sections of the Neck River, particularly along the impaired segment, to install BMPs designed to encourage stormwater to infiltrate into the ground before entering the Neck River. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

3) Evaluate municipal education and outreach programs regarding animal waste.

Madison can take measures to minimize waterfowl-related impacts such as encouraging residents and businesses to allow tall, coarse vegetation to grow in the riparian areas of the impaired segment of the Neck River that are frequented by waterfowl, particularly within parks and golf courses. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shoreline will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans may contribute to water quality impairments in the Neck River watershed and can harm human health and the environment. Animal wastes should be disposed away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

4) Ensure there are sufficient buffers on agricultural lands along Neck River.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in

place. Particular attention should be paid to those agricultural operations located along the impaired segment and along tributary streams of the impaired segment.

5) Continue monitoring permitted sources.

Currently the only data available for permitted discharges in the Neck River Watershed are for the MS4 outfalls in the Town of Madison (Table 6). There is currently no data available for sampling at the other permitted discharges in the Neck River watershed. Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 8 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Neck River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 8. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	**1**	**2**	**3**	**1**	**2**	**3**	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with “natural levels” if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 9: Neck River Bacteria Data

Waterbody ID: CT5107-00_01

Characteristics: Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **40%**

Single Sample: **92%**

Data: 2002, 2003, and 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the Neck River with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1843	Fort Path Road crossing (USGS location)	6/1/2006	20	wet	135
1843	Fort Path Road crossing (USGS location)	6/19/2006	85	dry	
1843	Fort Path Road crossing (USGS location)	6/26/2006	405†	dry	
1843	Fort Path Road crossing (USGS location)	7/5/2006	3100	wet	
1843	Fort Path Road crossing (USGS location)	7/17/2006	20	dry	
1843	Fort Path Road crossing (USGS location)	7/24/2006	84	dry	
1843	Fort Path Road crossing (USGS location)	7/31/2006	31	dry	
1843	Fort Path Road crossing (USGS location)	8/7/2006	170	dry	
1843	Fort Path Road crossing (USGS location)	8/14/2006	41	dry	
1843	Fort Path Road crossing (USGS location)	8/21/2006	74	wet	
1843	Fort Path Road crossing (USGS location)	8/28/2006	**4900* (92%)**	wet	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the Neck River with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1843	Fort Path Road crossing (USGS location)	5/29/2007	63	dry	168
1843	Fort Path Road crossing (USGS location)	6/4/2007	2500	wet	
1843	Fort Path Road crossing (USGS location)	6/11/2007	150	wet	
1843	Fort Path Road crossing (USGS location)	6/18/2007	140	dry	
1843	Fort Path Road crossing (USGS location)	6/25/2007	73	dry	
1843	Fort Path Road crossing (USGS location)	7/2/2007	104†	dry	
1843	Fort Path Road crossing (USGS location)	7/9/2007	190	dry	
1843	Fort Path Road crossing (USGS location)	7/16/2007	63	dry	
1843	Fort Path Road crossing (USGS location)	7/23/2007	390	wet	
1843	Fort Path Road crossing (USGS location)	7/30/2007	250	dry	
1843	Fort Path Road crossing (USGS location)	8/6/2007	98	dry	
1843	Fort Path Road crossing (USGS location)	8/13/2007	330†	dry	
1843	Fort Path Road crossing (USGS location)	8/20/2007	200	dry	
1843	Fort Path Road crossing (USGS location)	8/27/2007	74	dry	
1843	Fort Path Road crossing (USGS location)	6/3/2008	30	dry	**211* (40%)**
1843	Fort Path Road crossing (USGS location)	6/9/2008	4400	wet	
1843	Fort Path Road crossing (USGS location)	6/16/2008	330	wet	
1843	Fort Path Road crossing (USGS location)	6/23/2008	52	wet**	
1843	Fort Path Road crossing (USGS location)	6/30/2008	160	dry	
1843	Fort Path Road crossing (USGS location)	7/7/2008	100	dry	
1843	Fort Path Road crossing (USGS location)	7/14/2008	860	wet	
1843	Fort Path Road crossing (USGS location)	7/21/2008	520	dry	
1843	Fort Path Road crossing (USGS location)	7/28/2008	630	wet	
1843	Fort Path Road crossing (USGS location)	8/4/2008	270	dry	
1843	Fort Path Road crossing (USGS location)	8/11/2008	117†	dry	
1843	Fort Path Road crossing (USGS location)	8/18/2008	52	dry	
1843	Fort Path Road crossing (USGS location)	8/25/2008	97	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the Neck River with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1843	Fort Path Road crossing (USGS location)	6/8/2009	31	dry	97
1843	Fort Path Road crossing (USGS location)	6/15/2009	290	wet	
1843	Fort Path Road crossing (USGS location)	6/22/2009	330	wet	
1843	Fort Path Road crossing (USGS location)	6/29/2009	160	dry	
1843	Fort Path Road crossing (USGS location)	7/7/2009	110	wet	
1843	Fort Path Road crossing (USGS location)	7/13/2009	63	dry	
1843	Fort Path Road crossing (USGS location)	7/20/2009	63	dry	
1843	Fort Path Road crossing (USGS location)	7/27/2009	150	dry	
1843	Fort Path Road crossing (USGS location)	8/3/2009	150	dry	
1843	Fort Path Road crossing (USGS location)	8/10/2009	31	dry	
1843	Fort Path Road crossing (USGS location)	8/17/2009	41	dry	
1843	Fort Path Road crossing (USGS location)	8/31/2009	120	dry	
754	Upstream of Route 95 crossing	5/7/2002	130	dry	207
754	Upstream of Route 95 crossing	10/9/2002	330	dry	
754	Upstream of Route 95 crossing	4/15/2003	20	dry	NA
755	Upstream of Green Hill Rd crossing	8/15/2002	550	dry	NA

Shaded cells indicate an exceedance of water quality criteria

[†]Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on Neck River

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
1843	Fort Path Road crossing (USGS location)	2006-2009	15	35	149	407	95
754	Upstream of Route 95 crossing	2002-2003	0	3	95	NA	95
755	Upstream of Green Hill Rd crossing	2002	0	1	NA	NA	NA

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gages at Tweed KMMK station in New Haven, CT and at Hartford Bradley International Airport

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